

However, the Examiner's above understanding of Kao is not accurate.

The Introduction Of Inert Gas Prior To The First Stage In Kao Is Simply For Flushing Loose Particles From The Chamber

In Kao, the abstract states:

"Optionally, an inert gas can be flowed into the processing chamber prior to the first stage to remove loose particles from the processing chamber."

The above is explained in the specification as follows:

"an optional step in which an inert gas such as argon is flowed through the chamber prior to flowing any other cleaning gases, in order to flush loose particles from the processing chamber, may be added." (column 13, lines 24-27)

Thus, it is clear that in Kao, the introduction of an inert gas prior to the first stage is simply for flushing loose particles from the reaction chamber, not for obtaining a predetermined pressure in the reaction chamber. In Claim 1, the cleaning sequence is programmed to introduce an inert gas to obtain a predetermined pressure (or obtain a predetermined pressure by introducing an inter gas).

The Temperature Range of 400-700°C In Kao Is Not Reached By Reducing The Temperature

In Claim 1, the reduction of the temperature is conducted in an inert gas at a predetermined pressure. As explained above, in Kao, the introduction of inert gas is not for obtaining a predetermined pressure but simply for removing loose particles. Kao in no way suggests obtaining an inert gas environment prior to the first stage.

Further, Kao does not teach reducing the temperature. Kao states:

"The temperature of pedestal 12 (the heater) is preferably maintained between about 400.degree. C. and 700.degree. C., and is most preferably about 550.degree. C. This is another advantage of the present invention, in that the temperature need not be lowered to avoid over-etching of the chamber's components, as in the prior art." (column 17, lines 59-64)

"said cleaning temperature being substantially equal to a temperature at which a substrate is processed in the substrate processing chamber." (Claim 5)

Thus, in Kao, the temperature range is not reached by reducing the temperature. In Kao, instead of lowering the temperature, increasing the flow of inert gas at the second stage. Further, no prior art teaches reducing the temperature in an inert gas environment prior to the cleaning process. In the prior art, lowering the temperature is for reducing the etch rate, not for preventing the generation of aluminum fluoride.

In conclusion, Kao teaches none of: (i) achieving a predetermined pressure by introducing an inert gas, (ii) reducing the temperature prior to the cleaning process, (iii) reducing the temperature at the predetermined pressure obtained by an inert gas, and (iv) reducing the temperature to prevent the generation of aluminum fluoride. Kao does not mention the problem of aluminum fluoride and in no way suggests reducing the temperature prior to the cleaning process.

No Reason Or Motivation To Reduce The Temperature Prior To The Cleaning Process In The Prior Art

As described above, Kao does not teach reducing the temperature prior to the cleaning process. Kao teaches that by increasing a flow of inert gas, the etch rate is reduced in the second stage, and thus, it is not necessary to lower the temperature in the second stage as in the prior art (the etch rate is reduced as cleaning progresses). In the prior art, lowering the temperature is for reducing the etch rate as cleaning progresses. Thus, in the prior art, there is no reason or motivation to reduce the temperature prior to the cleaning process.

Frankel Mentions Problem of Aluminum Fluoride But No Reduction of Temperature, Especially When Using Aluminum Nitride

Frankel makes mention of a problem of aluminum fluoride. However, as the Examiner admits, Frankel in no way teaches introducing an inert gas and reducing the temperature prior to the cleaning process. Further, Frankel teaches away from conducting a cleaning process when using an aluminum nitride heater. Frankel states:

"aluminum tends to react with the fluorine containing compounds typically used in cleaning gases to form a layer of an aluminum fluoride compound that may eventually build-up and flake off into the chamber or onto the wafer, resulting in contamination (discussed in further detail below). Constructing the heater 25 of aluminum nitride effectively eliminates this problematic reaction during cleaning. (column 31, lines 60-67) (emphasis added)

In Claim 1, the susceptor is made of aluminum nitride. As explained in the specification, the inventors found that even when using the susceptor made of aluminum nitride, aluminum fluoride is generated, and by introducing an inert gas and reducing the temperature prior to the cleaning process, it can be effectively prevented (the first paragraph of page 4, for example).

Conclusion

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In conclusion, a combination of Frankel and Kao could not lead to Claim 1 as amended herein. Claim 1 could not be obvious over Frankel and Kao, and at least for this reason, the remaining dependent claims also could not be obvious over the references. Applicant respectfully requests withdrawal of this rejection.

CONCLUSION

In light of the Applicants' foregoing Remarks, it is respectfully submitted that the present application is in condition for allowance. Should the Examiner have any remaining concerns which might prevent the prompt allowance of the application, the Examiner is respectfully invited to contact the undersigned at the telephone number appearing below. Please charge any additional fees, including any fees for additional extension of time, or credit overpayment to Deposit Account No. 11-1410. A duplicate copy of this sheet is enclosed.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

Claim 1 has been amended as follows:

1. (Twice amended) A thin film forming apparatus comprising:

a reaction chamber for forming at a film formation temperature a thin film on a workpiece placed on a susceptor provided in the reaction chamber, said susceptor being made of aluminum nitride and provided with a heater for heating the workpiece, said reaction chamber being provided with a conveyer for loading and unloading the workpiece into and from the reaction chamber; and

a cleaning device for cleaning unwanted deposits adhering to the inside of the reaction chamber at predetermined intervals, said cleaning device comprising:

(i) a cleaning gas controller for introducing a cleaning gas into the reaction chamber and evacuating the reaction chamber after the cleaning treatment;

(ii) a cleaning gas activator for activating the cleaning gas in radical form; and

(iii) a temperature and timing controller comprising a program including a cleaning sequence which is activated after completion of film formation, said cleaning sequence programmed to (1) introduce an inert gas to the reaction chamber to obtain a predetermined pressure, (2) reduce the temperature of the susceptor at a predetermined rate for cleaning, at the predetermined pressure, (3) when reaching a cleaning temperature which is lower than the film formation temperature, actuate the cleaning gas controller and the cleaning gas activator, and (4) evacuate the reaction chamber.